Hybrid signal processing and machine learning algorithm for adaptive fault classification of wind farm integrated transmision line protection

ABSTRACT

The technological advancement in integration of Renewable Green Energy Sources (RGES) like Wind Farm Generators (WFG), and Photovoltaic (PV) system into conventional power system as a future solution to meet the increase in global energy demands in order to reduce the cost of power generation, and improve on the climate change impact. This innovation also introduces challenges in the power system protection by it being compromised due to injected fault current infeeds on existing facilities. These infeed leadto the undesired trip of a healthy section of the line, and protection system failure. This paper presents a soft computational approach to adaptive fault classification model on High VoltageTransmission Line (HVTL) with and without RGES-WFG integration topologies, using extracted one-cycle fault signature of voltage and current signals with wavelet statistical approach in Matlab. The results are unique signatures across all fault types and fault distances with distinct entropy energy values on proposed network architecture. The supervised machine learning algorithm from Bayesian network classified 99.15 % faults correctly with the operation time of 0.01 s to produced best-generalized model with an RMS error value of 0.05 for single line-to-ground (SLG) fault identification and classification. Best suitable for adaptive unit protection scheme integration.

Keyword: Entropy energy; Renewable green energy sources; Soft computation; Wind farm generator; Wavelet multiresolution